

10:45 a.m.

891-2

Quantifying Right Ventricular Regional Systolic Function: Tetralogy of Fallot Versus Normals Using Magnetic Resonance Imaging 1-D Myocardial Tagging

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Background: Right ventricular (RV) function is notoriously difficult to quantify. Previous studies of patients with Tetralogy of Fallot (TOF) have demonstrated decreased global systolic performance. To assess regional RV mechanics, we took advantage of MRI's unique ability to tag myocardial tissue. **Methods:** By performing 1-D tissue tagging perpendicular to the long axis in cine-MRI series in 4-chamber and RV long axis views, we measured regional systolic shortening fractions (RSF's) of myocardium throughout the RV. We standardized twelve regions that can be assessed in these views, including three regions each along the RV free wall, the interventricular septum (IVS), the superior RV wall toward the outflow tract, and the inferior/diaphragmatic surface. The population included 13 normals and 6 patients with Tetralogy of Fallot (TOF) s/p transannular patch repair, ages 2 months to 16 years. Using computer-assisted intensity mapping, regional shortening was measured in each of the specified regions. **Results:** In normals, areas with the smallest shortening fractions included the IVS near the atrioventricular canal (AVC) and the mid-IVS (20.5% and 18.1%). The most dynamic areas were the anterior free wall regions (near AVC 32%, mid 33.1%, apex 35.7%) and the mid- and apical-inferior wall (30.1% and 30.8%). These two groups were significantly different from one another (P 's all <0.0002). The remaining regions had intermediate shortening, including the RV outflow tract (24.9%), inferior AVC (22.3%), superior midwall (28.2%), superior apex (26.6%), and septal apex (23.1%). All regions had standard deviations of 4-9%. TOF patients had significantly decreased shortening in all mid-free wall regions (superior, anterior, and inferior) as well as in the anterior apical region ($p<0.05$). **Conclusions:** Our preliminary data shows that RSF's can be measured in the RV using 1-D myocardial tagging. Areas of greatest fibrous tissue content such as the IVS and RV outflow tract tend to have the smallest RSF's, whereas free wall areas tend to have greater RSF's. TOF patients have decreased free wall shortening despite the volume load to their RV, consistent with previous studies of global ejection fractions in TOF.

11:00 a.m.

891-3

Balloon Dilatation of Severe Aortic Stenosis in the Fetus: Technical Advances

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Introduction: It has been postulated that reduced flow through the left ventricle (LV) in utero, due either to inflow or outflow obstruction, can result in hypoplastic left heart syndrome (HLHS). Fetal intervention to relieve the valvular obstruction may prevent the development of secondary LV hypoplasia. Such therapeutic interventions require 1) appropriate identification and selection of patients, 2) optimal timing of the procedure, and 3) safe and effective relief of the obstruction. All of these criteria depend on the development of a reliable and effective technical application. **Methods:** Since March 2000, we have attempted to relieve aortic stenosis or atresia in 7 fetuses (22-29 weeks). At least three fetal echocardiographers concluded from the fetal ultrasound (U/S) that HLHS would be the most likely outcome at term birth. All fetuses had little or no flow across the stenotic aortic valve, severe LV dysfunction, reversal of aortic arch flow and either reversal or no flow across the foramen ovale. All had some degree of increased LV echogenicity. **Results:** In all 7 patients, access was obtained by U/S guided puncture of the LV with a 19 gauge cannula and subsequent attempted wire/balloon manipulation across the aortic valve. In Group 1 ($n=4$) the fetus was positioned and the LV apex accessed percutaneously. All 4 fetuses had successful LV access, although wire/balloon passage across the aortic valve and the establishment of increased antegrade flow succeeded in only one fetus. That fetus was delivered at 34 weeks gestation and at 9 months of age has mild aortic stenosis and good LV function. One fetus delivered 3 weeks after the procedure at 25 weeks gestation and died. The other two were born with HLHS. In Group 2 ($n=3$) the uterus was exposed via a lower transverse laparotomy, enabling substantially improved U/S visualization, fetal positioning and cannula manipulation. All 3 procedures were technically successful. One fetus with severe hydrops and cardiomegaly died within 24 hours; the other two have increased antegrade flow, improved LV function and are still in utero. **Conclusion:** Laparotomy and uterine exposure may improve technical success in performing therapeutic cardiac interventions in the fetus.

11:15 a.m.

891-4

Clinical Role and Technical Aspects of Cardiac Magnetic Resonance Imaging in Infancy

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Background: MRI has been demonstrated to be an important non-invasive diagnostic modality in patients with congenital heart disease; however, few studies have focused on young children. This study examined the clinical utility and technical challenges of cardiovascular MRI in infants.

Methods: All patients age <1 year undergoing cardiac MRI at Children's Hospital Boston between January 1999 and July 2002 were identified and their MRI records and clinical data were retrospectively reviewed.

Results: A total of 82 MRI studies (63% in-patients) were performed in 76 patients at a

median age of 102 days (range 1-358 days) and with a median weight of 5.0 kg (range 1.2-16.3 kg). All examinations were performed under general anesthesia using either a head ($n=48$), cardiac ($n=18$), shoulder ($n=13$), or 5" surface ($n=3$) RF receiver coil. No clinical decompensation or other complications occurred. The majority of studies (64%) were performed pre-operatively. Referral questions were pulmonary artery anatomy ($n=16$), aortic anatomy ($n=11$), vascular ring anatomy ($n=12$), airway compression ($n=10$), pulmonary venous anatomy ($n=10$), cardiac tumor ($n=7$), aorto-pulmonary collaterals ($n=4$) and other ($n=12$). Prior investigations for these questions included echocardiography (70%), cardiac catheterization (10%), bronchoscopy (7%), CT scan (2%), or TEE (1%). MRI provided the requested diagnostic information in all studies. Furthermore, in 15/82 (18%) examinations, MRI yielded an additional unsuspected diagnosis. Findings at surgery ($n=42$) and cardiac catheterization ($n=10$) were all concordant with those found by MRI. Systematic review demonstrated that airway anatomy was best shown with fast spin echo sequences and the thoracic vasculature by Gadolinium-enhanced 3D MR angiography.

Conclusion: Cardiac MRI is a useful and safe imaging modality in assessing thoracic vasculature and airway anatomy in infants with congenital heart disease. In some cases, it obviates the need for cardiac catheterization or bronchoscopy.

11:30 a.m.

891-5

Secondary Prevention of Cerebrovascular Events in Patients With Patent Foramen Ovale and Cryptogenic Stroke: AUSTRIAN-PFO-Registry

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Background: Paradoxical embolism is a well recognized cause of stroke. Treatment options are antiplatelet therapy, anticoagulation and closure of patent foramen ovale. However, therapy for patent foramen ovale (PFO) remains controversial. There are no accepted recommendations or guidelines for secondary prevention of cryptogenic stroke in pts with PFO.

Methods: We undertook a 7-year observation study in 288 pts with PFO and a cryptogenic cerebrovascular event (mean age 44 ± 11 years). Treatment options were antiplatelet therapy, oral anticoagulation with an target international normalized ratio (INR) range of 2.5 to 3.5, or interventional catheter-closure of the PFO.

Results: During a 7-year follow up of 288 pts (788.6 patient-years), 36 recurrent cerebrovascular events occurred. Antiplatelet therapy was established in 73 pts, oral anticoagulation in 211 pts and interventional closure of the PFO was performed in 205 pts. The overall recurrence rate was 16.5%/patient/year (95% CI 9.5 to 27). Recurrent cerebrovascular events occurred most frequent in pts with antiplatelet therapy (13%/patient/year; 95% CI 8.32 to 19.3). The recurrence rates were significantly lower ($p<0.05$) in pts on oral anticoagulation 2.7%/patient/year (95% CI 1.0 to 5.58) or after interventional PFO-closure, 0.87%/patient/year (95% CI 0.18-2.54). Target range of oral anticoagulation (INR 2.5 to 3.5) was achieved in 90%. **Conclusion:** Oral anticoagulation (INR 2.5-3.5) is superior to antiplatelet therapy and achieves comparable outcomes with interventional closure of PFO for secondary prevention of recurrent cerebrovascular events in patients with PFO and cryptogenic stroke.

11:45 a.m.

891-6

Mild Aortic Valve Insufficiency: A Mid-Term Complication of Percutaneous Closure of Atrial Septal Defects and Patent Foramen Ovale

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Background: Percutaneous transcatheter closure of atrial septal defects (ASD) or patent foramen ovale (PFO) is used as an alternative to medical therapy or heart surgery. Focus of follow-up studies after implantation were procedural success, degree of residual interatrial shunts and recurrence rate of thromboembolic events. Although a significant deterioration of the aortic root and the mitral valve resulting in aortic and mitral regurgitation was described after surgical closure of ASD, to our knowledge, no study investigated the mid-term functional and structural effects on the aortic and mitral valve caused by the implanted closure device.

Methods: 86 patients underwent percutaneous closure of ASD or PFO with a double umbrella closure device (Cardia PFO-Star or Amplatzer Septal Occluder). ASD were secundum type defects with a mean size of 15 mm (8 to 22 mm) measured by transthoracic echocardiography (TEE). Percutaneous closure of PFO was performed in patients with cryptogenic cerebrovascular embolism.

Results: A primarily successful implantation procedure could be performed in over 95%. TEE three months after implantation revealed sufficient closure without residual shunt in 84% of patients with ASD and in 88% of patients with PFO. Compared with TEE findings pre implantation, no increase in mitral or aortic regurgitation (AR) was found. However, a follow-up study six months after closure demonstrated an increase of AR in 4 patients with ASD (13%) and in 9 patients with PFO (16%), the AR jets emerged in the center of the aortic valves and ranged from mild (77%) to moderate (23%) in patients having no or minimal AR before implantation. No significant changes on mitral valve function were found.

Conclusion: Six months after closure of ASD or PFO with a double umbrella device, TEE revealed mild AR in 13% of closed ASD and in 16% of closed PFO. A possible reason for developing AR is traction on the root of the non coronary aortic cusp caused by the umbrella endothelialisation process shortening the aortic rim of the atrial septum.